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THE NEED TO BREAK WITH TRADITION

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THE NEED TO BREAK WITH TRADITION

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Tradition may be both a benefit and a detriment. Undoubtedly, the tradition of high quality in performance, material, service or workmanship is one that should be followed or cultivated. The mention of Toledo or Damascus steel bespeaks a goal in quality that is truly traditional. On the other hand, following traditional practices with little thought of their background or basic concepts leads one into an ever deepening rut or trench whose unshored sides eventually collapse and engulf him. The blind following of tradition or "worship of sacred cows" as L.L. Hedgepeth[1] has so aptly phrased it, has been a great hindrance to progress in all lines of endeavor. There is a strong human tendency to follow or be bound by tradition and to ridicule or slander those who would vary or stray from the well-worn path. Columbus, Copernicus, Galileo, and countless others were all persecuted and suffered because of their efforts to break with tradition. This inertia to depart from the well-beaten road that follows precedent without rhyme or reason has too often delayed for years many urgently needed reforms and the use of new inventions. To quote Max Planck[2] in his autobiography: "A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it."

Those who oppose departure from traditional practices often point triumphantly to the failures of those who have taken the "wayward" step. It is most certainly true that there have been many failures - sometimes disasterous - because of varying from tradition. It is equally true that any action will ultimately rise or fall solely upon its own merit. If ideas, procedures, designs, or action are based upon sound logical principles, they will last and outride any storm of criticism or abuse heaped upon them.

The handicap of tradition may only be overcome by a clear analysis of the entire problem following a thorough study of all basic factors involved. This thorough study and clear understanding of such basic factors is absolutely essential before departing from conventional practices. As has already been stated, only too often engineers failing to make such analysis or lacking understanding of the basic factors have met disaster by either unwarrantedly following the tradition or unjustifiably departing therefrom. Is then this tendency to

1. Stream Pollution Abatement Problems of Industry - L.L. Hedgepeth. Technical Consultant, American Cyanamid Co., Bound Brook, N.J. - Paper delivered at New Orleans Convention, A.S.C.E., March 5, 1952. Assn. A.S.C.E., San. Engr. Div. (Com. Prog. & Publ.)
2. Scientific Autobiography - Max Planck - Philosophical Library - N.Y. -1949.

blindly follow tradition due to a lack of understanding of basic principles, or is it indifference and a desire to take the easy way to save expense of time and effort necessary to give the problem the thought and planning it requires? In either case, engineering definitely has no place for such attitudes.

A few examples might be cited to better illustrate the problem. The art of war is often so spoken of since one is dealing with biological factors represented by troops where such intangibles as their morale, physical condition, training, leadership, etc., must be taken into consideration, and rigid formulas cannot be used as with mathematical or chemical problems. Every military commander makes an "estimate of the situation" for each campaign or encounter with the enemy. This estimate may be a very brief and simple one when small units are concerned, or it may be quite involved when dealing with an army or a group of armies. It basically covers, first, the commander's own and the enemy's mission; then such factors as training, equipment, morale, numbers of opposing troops; supply, terrain, and plans available; and finally, the most desirable action to accomplish the mission after considering all factors involved. A successful and outstanding commander is one whose understanding of all basic factors is thorough and who will vary from tradition without violating these basic concepts. Consider the collapse of France in World War II. According to the French, the Germans were traditionally bound to make a direct frontal attack on the heavily fortified Maginot Line as had been done at Verdun in World War I. Hitler, departing from tradition, by-passed the Maginot Line, used the Stuka plane as his artillery in the dense Ardennes Forest, and the results are history.

One may ask what has this to do with Sanitary Engineering? Translated into nonmilitary terms, it might be summarized as: What are we trying to accomplish? Under what conditions are we working? What tools do we have?

The Sanitary Engineer above all others has more to do with biological elements and so has greater need for a proper estimate of the situation and a thorough evaluation of all basic factors. Need for breaking tradition is double, since without such a break no progress can be made, or if the "sacred cows" are blindly worshipped, grave errors may result.

The conventional B.O.D. test might be taken for consideration. Trade wastes are customarily evaluated on their B.O.D. content and treatment charges often made dependant thereon or on the "population equivalent" the B.O.D. supposedly represents. Frequently, this procedure has brought serious complications and failures to achieve the desired goal. An analysis of this might be proper. First, what is B.O.D.? Simply stated, it is the consumption or depletion of oxygen by the biological organisms present in the water during a predetermined period, usually five days. How is it made? Dissolved oxygen is determined in a sample; the sample incubated for the desired period and residual dissolved oxygen determined. The difference in dissolved oxygen before and after incubation is the B.O.D. In reality then this test is a test for dissolved oxygen. The standard test for dissolved oxygen depends on oxidizing manganous salts, release of iodine, and titrating this iodine with thiosulfate. Anything affecting these chemical reactions in any way will affect the results of the test. Sewages or industrial wastes frequently contain substances that will have a very marked effect on these reactions and adherence to traditional methods may often cause widely varying and erroneous results. Thus it becomes mandatory, in order to obtain proper values to re-evaluate all the basic factors contributing to the B.O.D., to re-examine the methods of determination and to interpret the results obtained in light of the new factors developed.

Another problem where sound logical principles must be applied is in the interpretation and evaluation of population equivalent. Population equivalent is based on pounds of B.O.D. per person for average domestic sewage. But what is domestic sewage? Its content may vary widely between cities, depending on many factors; e.g., climate, economic status of the community, geography, age of sewage, etc.; also any given community unusual conditions may cause a decided change in character of sewage. This is well illustrated by the marked changes in sewage content, e.g., fats or grease, etc., observed in the sewages of certain cities during the war years or depression years. Blindly following rigidly prescribed methods of evaluation can only lead to erroneous results and conclusions.

Let us consider another side of the problem of sewage treatment and disposal. The late C. C. Kennedy[3] at the inaugural meeting of the California Sewage Works Association twenty-four years ago, delivered a paper entitled "Know Your Sewage." No more timely words have ever been spoken, yet the writer has often heard engineers say: "Design the plant just like X; only proportion it for differences in flows." Why just like X? Is the sewage strength the same? The plant location similar? The point of disposal similar? Climatic conditions similar? It would seem fundamental that all these factors and many others should be given consideration. If an Imhoff tank is good for X, it does not necessarily follow that it should be used for Y. Two men may look somewhat alike, be the same height and weight, and even the same color, but their personal likes and dislikes may differ radically. Even identical twins have some points of differences.

As another example of failure to readily grasp basic concepts of sewage treatment, a Texas engineer about thirty years ago obtained a patent on the use of a spetic tank prior to the activated sludge process. Up to that time, the activated sludge process generally consisted of either admitting raw sewage directly to the aerator tanks or passing it through fine screens. Great emphasis at the time was laid on keeping the sewage as fresh as possible. Loud and long, therefore, were the cries of many engineers against this "radical" departure of using septic tanks prior to aeration process. "The aerators would have to work overtime to counteract the septic sewage," was the cry. The effluent of the septic tank of course would be lacking in oxygen and would probably contain hydrogen sulfide. However, let us stop and consider a minute - make an estimate of the situation - so to speak. What was one difficulty of the activated sludge process at that time when using raw sewage? Large sewage solids were very slow in breaking down thereby causing a poor quality of effluent. How could these large solids be removed? By fine screening was one answer. How could a greater removal of solids be accomplished? By settling. What is the primary purpose of the septic tank? To settle sewage and give a better removal of solids than by fine screening. The smaller the particle size of the solids the more easily they are broken down in the aeration process. Dissolved material is much more readily worked on than solids; so the fact that some hydrogen sulfide may be present is not nearly so important as the fact that there be no large solid particles present.

That the use of a septic tank or a presettling tank is fundamentally sound is attested to by the fact that presettling tanks are practically universally used in all modern activated sludge plants at present. The long retention

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3. Know Your Sewage - C.C. Kennedy - Jl. Calif. Sewage Works Assn. Vol. I, No. 1 - 1928.

time of the septic tank has now been superseded by a much shorter retention period and mechanical sludge removal. However, the basic principle of desirability of maximum removal of solids as compared with freshness of the sewage still holds.

Turning for a moment from the field of sewage treatment to that of water treatment. There is one idol before which engineers, including many in health departments, are still kowtowing: that is the permissible filtration rate with rapid sand filters. From the time the first rapid sand filters were developed, nearly sixty years ago,[4] to date many engineers have arbitrarily held that for domestic use no rate greater than two gallons per square foot per minute should ever be used. Why? Undoubtedly, this rate was developed as being the highest rate commensurate with quality of effluent for a given quality of water under given conditions. Through the years this rate has satisfactorily filled many varying situations. There are numerous occasions, nevertheless, where higher rates could be used with considerable economy of design and satisfactory efficiency of operation. There are instances where filtration may be done solely for aesthetic consideration; where health department requirements have long been satisfied by chlorination only; where the raw water is such that bacterial quality is no problem and physical quality only would indicate desirability of filtration. In situations such as these, it is quite startling to find an iron-clad edict from the health department banning any rate in excess of the venerable two gallons. Why? If the supply was satisfactory with chlorination alone, what harm or danger could arise from a three or a five gallon rate? Just what are we trying to accomplish by filtration and what is the quality of our supply in a particular case? Is it bacterial or turbidity removal from a poluted raw water? - or is it merely removal of taste and odors, softening? - or just that we want to do a little polishing of an otherwise good quality water? If the latter, then what possible harm can be done by a higher rate? In these instances, a proper estimate of the situation would clearly show the fallacy and futility of adhering to hoary tradition.

One final example of an urgent need to depart from tradition is with our standards for bacterial quality of water. This may be more properly in the field of the Bacteriologist. But none the less it is of vital concern to the Sanitary Engineer, and his thinking can have considerable effect on the development and application of these standards.

For many years the coliform test has determined the acceptability of water for domestic use. Why? "A man is known by the company he keeps." Certain bacteria are normal inhabitants of the intestines of man and warm-blooded animal; therefore, if these bacteria are found, intestinal discharges may be present and also pathogenic bacteria. This is good sound reasoning and most certainly on the safe side.

The weak spots are two-fold: The first is that the indicator organisms are a group of bacteria, some of which may or may not be of intestinal origin. In regions where streams receive sewage, safety may dictate that no differentiation should be made. There are, however, many sections of the country, e.g., the semi-arid regions of the southwest where it is known sewage does not enter the water supply, yet frequently water samples fail to meet the standards. This is recognized by the U.S. Public Health Service, since they

4. Providence, R.I. 1893-94, E.B. Weston; Louisville & Cincinnati, 1895 - 1898, G.W. Fuller, Pittsburg, Pa., 1897, Allen Hazen; Washington, D.C. 1899, A.M. Miller; New Orleans, 1901, Robt. S. Weston.

permit the results of a sanitary survey to be considered along with the bacteriological analyses. Even the results of a sanitary survey, however, cannot outweigh the results of the bacterial analyses. As long as the coliform group is recognized as indicative of pollution, its presence will still condemn a water, and few sanitary engineers would dogmatically state that no pollution was present when confronted with adverse laboratory results. The coliforms are there, and we cannot prove that they did not come from humans. In the final analysis, we cannot ignore their presence.

The second weakness of these standards is the time factor. We are too complaisant in our attitude that thirty-six or more hours must elapse before we know if contamination is definitely absent or present. Under present practices to be safe we must always live under apprehension of the cry of "wolf." The prisoner must be considered guilty until proven innocent, and this cannot be done until he is executed. The water is consumed long before we definitely know its quality. We cannot detect failure of purification equipment or an unexpected slug of pollution until long after its occurrence. It is fully realized that bacteriological analysis cannot be completed with the same speed as many chemical tests. However, a rigorous evaluation of present standards and a long searching look at our goal should give us a procedure with an answer of equivalent value in considerable less time. Of far greater importance, however, is the need for rapid bacteriological tests of a specific nature in connection with possibilities of biological warfare or sabotage. Under these conditions the traditional coliform test completely breaks down in significance. If it is proposed to use typhoid, dysentery, cholera, or other pathogens to contaminate a supply, few saboteurs would be considerate enough to also add coliforms to give us warning.

New and more rapid methods are urgently needed. The U.S. Public Health Service is now working on this problem following initial work by Dr. Alexander Goetz on membrane filters for the Chemical Warfare Service at Cal. Tech. This method has great promise in developing bacterial colonies that may be differentiated or classified in eighteen hours or less.

From the foregoing, it might appear that Sanitary Engineers are either possessed of closed minds and generally unprogressive, or that the writer is a confirmed pessimist. Such is definitely not the case. There are many engineers whose contributions to the profession have produced long strides toward the goal of human betterment. Many are the instances where tradition has been defied and bold steps taken to depart from customary practices to affect economies and increased efficiencies in design and operation. It is unfortunate, however, that our human tendencies are such that we often long remember the failures and soon forget the successes. It has been said, "When a doctor makes a mistake, he buries it; when an engineer makes a mistake, it buries him." This tendency to brand one as incompetent because of but one failure often acts as a deterrent to departing from tried practices. If, however, one has a clear concept of basic principles and follows them out logically, he need not be apprehensive of failure.

In each of our problems let us ask: Why are we acting so? Is it just because it is the line of least resistance? - or is it because it is the logical well thought-out step? Are we cutting the cloth to fit the person? - or is it going to be a ready-made suit with no alterations because it is the easiest and cheapest to do? Most of us, because we are engineers, give the problem the study it deserves. There are those, however, who follow the easy way. The former succeed; the latter fall by the wayside. If, however, the latter become

the majority, then our profession goes down with them and other allied groups take over. Let us then continually take stock of ourselves and see that each of us is in the progressive group following tradition where necessary, boldly making breaks wherever warranted, but with our actions always firmly based on sound principles. In that way and that way only can our profession grow and advance and maintain the respect that is due.